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COAL STRENGTH PARAMETERS DERIVED FROM POINT LOAD INDEX TESTS, SYDNEY COALFIELD, NOVA SCOTIA

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Cape Breton Coal Research Laboratory

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by

T.R.C. Aston*, L.S. O'Leary** and D.J. O'Brien**

SUMMARY

Current CBCRL research programmes have resulted in a need for rock strength data for various strata types encountered in the Sydney Coalfield. Since CBCRL's rock testing facilities are not yet fully operational, a programme of irregular sample point load testing has been initiated to establish a preliminary geotechnical data base. Uniaxial compressive and tensile strength values have been derived from point load index tests conducted on coal samples obtained from four mine sites in the Sydney Coalfield, namely Lingan, No. 26, Prince and the NOVACO Point Aconi site. Strength values are given both parallel and perpendicular to the bedding plane and an anisotropy index calculated.

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ESSAI DE CHARGE CONCENTRÉE POUR DÉTERMINER LES PARAMÈTRES DE RÉSISTANCE DU CHARBON PROVENANT DE LA HOUILLÈRE DE SYDNEY, NOUVELLE-ÉCOSSE

par

T.R.C. Aston*, L.S. O'Leary** et D.J. O'Brien**

RÉSUMÉ

Les programmes de recherche en cours du LRCCB ont démontré la nécessité de données précises sur la résistance des roches de diverses couches géologiques de la houillère de Sydney. Les installations du LRCCB n'étant pas encore entièrement en opération, on a élaboré un programme d'essais de charge concentrée sur des échantillons irréguliers afin d'établir une base de données géotechnique préliminaire. Les propriétés de résistance à la compression uniaxiale et à la traction ont été déterminées au moyen d'essais de charge concentrée sur des échantillons de charbon provenant de quatre sites miniers de la houillère de Sydney dont les mines Lingan, N° 26, Prince et Navaco Point Aconi. On donne les propriétés de résistance des plans parallèle et perpendiculaire de la zone de stratification et on fait le calcul de l'indice d'anisotropie.

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*Chercheur scientifique et **technologues, Laboratoire de recherche du Cap-Breton LRC, CANMET, Énergie, Mines et Ressources Canada, Sydney.

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INTRODUCTION

In June 1983, a Gateroad Deformation Study was initiated at the Lingan and No. 26 mines, Sydney Coalfield, Nova Scotia. During a six month period, in excess of 4000 measurements and 400 photographs were collected from 35 km of accessible gateroad (1). The object of the study was to obtain a data base on existing gateroad deformation processes and provide information for more detailed ongoing research programmes (2,3). In addition, since little geotechnical information is available concerning strata properties in the Sydney Coalfield, a programme is currently being initiated to establish a geotechnical data base for the Sydney Coalfield.

Strata preparation/testing facilities at CBCRL are presently limited until renovations to the laboratory are completed (anticipated 4th quarter of 1984) and equipment acquisitions finalised. Therefore, in order to obtain preliminary coal strength data for both the Gateroad Deformation Study and the Geotechnical Data Base, a programme of point load testing of irregular samples was initiated.

Coal samples were collected and tested from the Lingan, No. 26 and Prince mines as well as the NOVACO open pit site.

POINT LOAD TESTING

The point load testing apparatus is shown in Figure 1 and its operation fully described in the Pit Slope Manual (4).

Essentially, the test involves loading a sample of known shape and size between two points, Figure 2. Extensive work (4,5,6) has reported the factors affecting the test and proposed the method as a valid means of determining a rock strength index.

The point load index value, I_s, is derived using equation (1).

$$I = P/D2 \qquad \text{Eq 1}$$

where P = Point Load (MPa)

D = Diameter of the Specimen (mm)

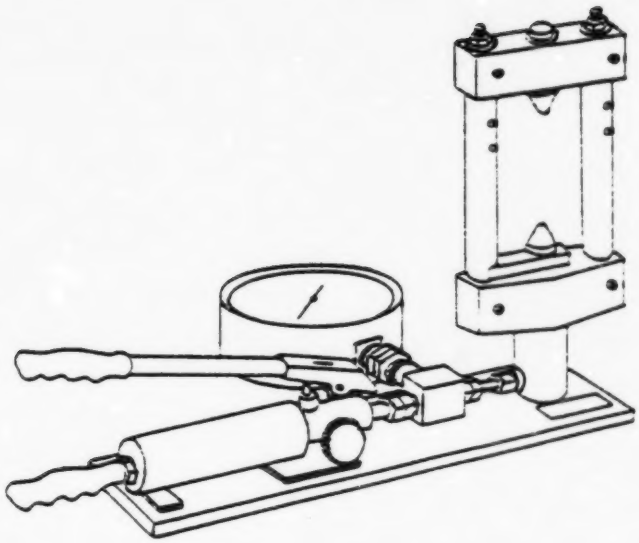
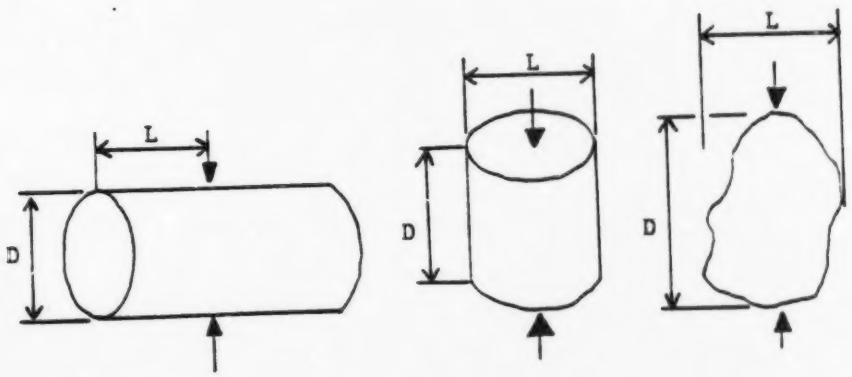


Figure 1 - Point-Load Test Apparatus (Manufactured by ELE Ltd., U.K.) (Ref. 4)



$L > 0.7\ D$

Diametral Test

$\frac{D}{L} = 1.1 \pm 0.05$

Axial Test

$\frac{D}{L} = 1.0$ to 1.4

Irregular Lump Test

Figure 2 - Types of Point Load Strength Tests (Ref. 4)

In the case of irregular specimen testing, the samples should be spheroidal in shape, with a preferred diameter of 50 mm. However, maximum and minimum diameters of 100 mm and 25 mm are acceptable (4). The acceptable ratio of the longest to shortest diameter of the specimen falls between 1.0 and 1.4, Figure 2.

TESTING PROGRAMME

Samples were collected from:

Lingan	- Harbour Seam	- Oversized coal removed from the mine run at the 'scalper'.
No. 26	- Harbour Seam	- Oversized coal collected from the main coal belt.
Prince	- Hub Seam	- Oversized coal removed from the mine run at the 'scalper'.
NOVACO (Point Aconi)	- Main Seam	- Oversized coal collected from the 'cut'.

In each case, a minimum sample size of 100 mm was collected from the mine site and the samples subsequently prepared in the laboratory (reduction to between 25 and 50 mm and roughly spheroidal in shape). It is important to note that the samples were tested within 24 hours of being collected in order to prevent deterioration.

Between 50 and 60 samples were tested from each mine site, both parallel and perpendicular to the coal bedding. The results were subsequently tabulated and I_s values calculated for each of the test samples. A mean batch diameter and index strength was then calculated, Table 1. The raw data sheets are given in Appendices A to D.

TEST RESULTS

It is stated (4,5,6) that the diameter of the specimen has a significant influence on the derived index value, even though the length/diameter criteria are maintained. It is therefore useful to standardize the reporting of index data according to specimen diameter.

Table 1 - Point load index strength values of coal, Sydney Coalfield, Nova Scotia

Date	Site	Direction of loading relative to bedding	Mean index strength value Is_{54} (MPa)	Mean specimen diameter (mm)
21/12/83	No. 26	Parallel	0.47	38.0
		Perpendicular	0.71	36.5
21/12/83	Lingan	Parallel	0.87	36.0
		Perpendicular	1.90	36.5
5/ 1/84	Lingan	Parallel	0.77	43.5
		Perpendicular	2.23	29.0
5/ 1/84	Prince	Parallel	1.23	36.0
		Perpendicular	0.65	33.0
5/ 1/84	NOVACO Point Aconi	Parallel	0.44	35.5
		Perpendicular	0.32	30.0

The Pit Slope Manual (4) gives a size correction chart for calculating the Is value to a reference diameter of 50 mm. However, an extensive study by Hassani et al (6) has shown that mathematical equations can be derived which represent the correction curves and therefore avoid the problems associated with distortion and inadequate reproduction of the original chart.

Index values have therefore been corrected to 54 mm (standard NX size core) using equation 2, (6):

$$\text{Log}_{10}\text{Is}_{54} = 0.229 + \text{Log}_{10}\text{I}_s - 1.008e^{-0.0274D} \qquad \text{Eq 2}$$

where I = Index Strength (mPa)

D = Specimen Diameter (mm)

Hassani et al (6) has also reported relationships between the point load index strength, uniaxial strength and tensile strength as follows:

Uniaxial Compressive Strength

$$c = 29.24\ \text{Is}_{54} \qquad \text{Eq 3}$$

Tensile Strength

$$T_s = 2.78\ \text{Is}_{54}$$

Encouraging results have also been reported for calculating triaxial strength data from point load testing using various established models (6), although no attempt has been made here.

Tabulated Is_{54}, compressive and tensile strength values for the tested coal samples are given in Table 2.

Table 2 - Point load index, uniaxial compressive strength, tensile strength and Hardgrove grindability index values of coal, Sydney Coalfield, Nova Scotia

Date	Mine site	Direction of loading relative to bedding	Index strength Is_{54} (MPa)	Calculated uniaxial compressive strength (MPa)	Calculated tensile strength (MPa)	Anistropy index Is_{54}	Hardgrove grindability index
21/12/83	No. 26	Parallel	0.32	9.3	0.89		
		Perpendicular	0.46	13.5	1.28	1.44	65-70
21/12/83	Lingan	Parallel	0.58	16.9	1.60		
		Perpendicular	1.23	35.8	3.41	2.13	56-62
5/ 1/84	Lingan	Parallel	0.58	16.9	1.61		
		Perpendicular	1.22	35.7	3.39	2.10	56-62
5/ 1/84	Prince	Parallel	0.75	22.0	2.10		
		Perpendicular	0.41	12.0	1.14	0.54	59-63
5/ 1/84	NOVACO	Parallel	0.26	7.6	0.72		
	Point Aconi	Perpendicular	0.18	5.2	0.50	0.69	58

DISCUSSION

In Table 2 it appears that both the Lingan and No. 26 coal (Harbour Seam) is stronger perpendicular to the bedding than parallel to it. Alternatively, the Prince (Hub Seam) and NOVACO Point Aconi (Main Seam) coals are stronger parallel to the bedding than perpendicular to it. The weakest coal comes from the NOVACO Point Aconi site and may be due to either weathering effects (directly due to the opening of the cut or indirectly due to the seam being located close to the outcrop) or blast induced fracturing.

In each case, the samples from the underground mines were collected from the equivalent of the main coal conveyor at surface. As such, no indication is given as to which face or where abouts on the coal face any particular sample originated (roof, middle or floor). The samples were carefully selected by eye in order to eliminate any containing stone or obvious poor quality coal. However, variations in both lithology and structural competency do occur. In the case of the coal from Prince mine, quantities of pyrite were visible within the samples and this may have affected the resultant strength.

In the Lingan and No. 26 samples, a marked variation in strength properties can be seen, particularly in the direction perpendicular to the bedding. It is known that the No. 26 workings are considerably more gassy than those at Lingan and may therefore contain a greater internal gas pressure which partially account for the lower strength values seen in Table 2.

The Hardgrove grindability values of coal sampled from similar locations at each of the mine sites (7), Table 2, show little indication that the coal strength can be correlated to the grindability index.

Finally, two sampling suites undertaken at Lingan mine on different dates show that comparible results can be obtained. It is therefore hoped to undertake similar sampling/testing programmes at quarterly intervals in order to establish a preliminary coal strength data base. However, it should be noted that this data base will only provide 'first order approximations' of coal strengths from each mine. Ideally, when the rock preparation/testing facility at CBCRL becomes fully operational a more detailed programme of coal property testing can be initiated.

Finally, raw data obtained during this programme is presented in Appendices A,B,C and D. The reason for the inclusion of this data is that in the future refined or even new techniques for the determination of rock strength parameters from point load test data may become available. It is therefore considered important that the original data used to derive the No. 26, Lingan, Prince and NOVACO coal strengths be available for re-evaluation by future researchers.

CONCLUSIONS

The point load index test provides a simple, effective means of deriving rock strength parameters under field and/or laboratory conditions. However, inherent problems do exist with the technique, especially when deriving compressive and tensile strength values from the original index values. The values given in Table 2 should therefore be treated with caution and used primarily as a 'good first order approximation' of coal strength at the four mine sites. Finally, it is intended to conduct further irregular sample point load testing on both coal and other rock types within the Sydney Coalfield, in order to establish a data base of preliminary strength values to which can be added more sophisticated results at a later date.

ACKNOWLEDGEMENTS

The authors wish to gratefully acknowledge the support and assistance given by Cape Breton Development Corporation and NOVACO personnel at the Lingan, No. 26, Prince and Point Aconi mine sites during collection of the coal samples.

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APPENDIX A

Energy, Mines and Resources CANADA

POINT LOAD STRENGTH INDEX

Sample LINGAN - COAL

IRREGULAR LUMP

PARALLEL TO BEDDING

Location MINE RUN AT 'SCALPER'

Borehole N/A Depth N/A

Sample No. N/A

Date 21 - 12 - 83

Tested by [illegible] B.C.

pg. 1 of 3.

Average water content: N/A %

Average degree of saturation: N/A %

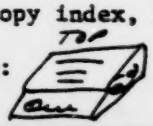
Test Type	Specimen No.	D (DIAM)	P (load)	D^2	Is	Is(50)	Median Value	Notes
POINT LOAD	1	45	1.425	0.002025	712			
	2	35	0.500	0.001225	417			
	3	25	1.075	0.000625	179			
	4	65	1.900	0.004225	452			
	5	55	0.700	0.003025	233			
	6	50	1.475	0.0025	590			
	7	40	1.125	0.0016	703			
	8	20	0.550	0.0004	1375			
	9	50	2.900	0.0025	1160			
	10	45	0.775	0.002025	388			
	11	20	0.650	0.0004	1625			
	12	55	3.950	0.003025	1316			
	13	45	1.125	0.002025	562			
	14	40	1.000	0.0016	625			
	15	40	0.975	0.0016	609			
	16	20	0.650	0.0004	1625			
	17	60	0.975	0.0036	271			
	18	45	0.600	0.002025	300			
	19	30	1.100	0.0009	1222			
	20	40	1.075	0.0016	672			
CUM. TOTAL		825			15036			

Median values of strength index, $I_s(50)$

Parellel to plane of weakness: N/A Mpa

Perpendicular to plane of weakness: N/A Mpa

Anisotropy index, $I_a(50)$ = ——— = N/A

Remarks: 

COAL TESTED PARALLEL TO BEDDING PLANE

Energy, Mines and Resources CANADA

POINT LOAD STRENGTH INDEX

Sample LINGAN - COAL
IRREGULAR LUMP
PARALLEL TO BEDDING
Location MINE RUN AT 'SCALPER'
Borehole N/A Depth N/A
Sample No. N/A

Date 21-12-83
Tested by GSC - B.C.

Pg. 2 of 3

Average water content: N/A %
Average degree of saturation: N/A %

Test Type	Specimen No.	D (DIAM)	P (load)	D^2	Is	Is(50)	Median Value	Notes
POINT LOAD	21	20	0.600	0.0004	1500			
	22	45	1.675	0.002025	827			
	23	30	1.150	0.0009	1278			
	24	25	0.800	0.000625	1338			
	25	25	1.025	0.000625	1708			
	26	50	1.275	0.0025	510			
	27	45	1.325	0.002025	662			
	28	25	0.900	0.000625	1500			
	29	40	0.850	0.0016	531			
	30	35	0.650	0.001225	541			
	31	25	0.625	0.000625	1041			
	32	45	0.800	0.002025	400			
	33	25	0.575	0.000625	958			
	34	35	1.400	0.001225	1167			
	35	25	0.425	0.000625	708			
	36	20	0.725	0.0004	1812			
	37	40	0.950	0.0016	594			
	38	30	0.775	0.0009	861			
	39	50	1.400	0.0025	560			
	40	35	0.350	0.001225	292			
CUM. TOTAL		670			18,793			

Median values of strength index, $I_s(50)$

Parellel to plane of weakness: N/A Mpa

Perpendicular to plane of weakness: N/A Mpa

Anisotropy index, $I_a(50) = \frac{\quad}{\quad}$ = N/A

Remarks: TBD COAL TESTED PARALLEL TO BEDDING PLANE

Energy, Mines and Resources CANADA

POINT LOAD STRENGTH INDEX

Sample LINGAN COAL
IRREGULAR LUMP
PARALLEL TO BEDDING
Location MINE RUN AT 'SCALPER'
Borehole N/A Depth N/A
Sample No. N/A

Date 21-12-83
Tested by KGL - B.C.
pg. 3 of 3
Average water content: N/A %
Average degree of saturation: N/A %

Test Type	Specimen No.	D (DIAM)	P (load)	D^2	Is	Is(50)	Median Value	Notes
POINT LOAD.	41	25	0.200	0.000625	333			
	42	40	1.475	0.0016	922			
	43	30	1.300	0.0009	1444			
	44	20	0.900	0.0004	2250			
	45	45	0.825	0.002025	412			
	46	30	1.900	0.0009	2111			
	47	25	0.350	0.000625	583			
	48	45	1.250	0.002025	625			
	49	35	0.975	0.001225	812			
	50	25	0.500	0.000625	833			
	51	40	0.750	0.0016	469			
	52	30	0.825	0.0009	916			
	53	25	0.300	0.000625	500			
CUM.	TOTAL	415			12210			
TOTAL		1910			46,039			

MEAN I_S = $\frac{46,039}{53}$
= 868.66038 KN/m²
= 0.86866 MR

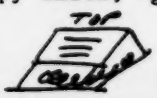
AV. DIAM. = $\frac{1910}{53}$
= 36.037736 mm
= 0.03604 m

Median values of strength index, $I_s(50)$

Parellel to plane of weakness: N/A Mpa

Perpendicular to plane of weakness: N/A Mpa

Anisotropy index, $I_a(50)$ = ——— = N/A

Remarks: TOP  COAL TESTED PARALLEL TO BEDDING PLANE

Energy, Mines and Resources CANADA

POINT LOAD STRENGTH INDEX

Sample LINGAN - COAL
IRREGULAR LUMP
PERPENDICULAR TO BEDDING
Location MINE RUN AT 'SCALPER'
Borehole N/A Depth N/A
Sample No. N/A

Date 21 - 12 - 83
Tested by L. Jim O'Leary
pg. 103
Average water content: ____ %
Average degree of saturation: ____ %

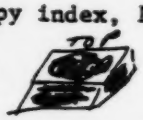
Test Type	Specimen No.	D (DIAM)	P (load)	D^2	Is	Is(50)	Median Value	Notes
POINT LOAD	1	50	1.075	0.0025	430			
	2	40	1.000	0.0016	625			
	3	30	1.600	0.0009	1778			
	4	45	2.775	0.002025	1370			
	5	35	1.550	0.001225	1265			
	6	30	1.300	0.0009	1444			
	7	50	1.425	0.0025	570			
	8	30	0.875	0.0009	972			
	9	40	2.550	0.0016	1594			
	10	30	0.725	0.0009	805			
	11	50	1.700	0.0025	680			
	12	40	3.375	0.0016	2109			
	13	25	3.475	0.000625	5560			
	14	45	1.000	0.002025	494			
	15	35	2.425	0.001225	1980			
	16	25	1.925	0.000625	3080			
	17	40	2.450	0.0016	1531			
	18	25	2.050	0.000625	3280			
	19	50	4.825	0.0025	1930			
	20	35	2.300	0.001225	1877			
CUM. TOTAL		750			33374			

Median values of strength index, $I_s(50)$

Parellel to plane of weakness: N/A Mpa

Perpendicular to plane of weakness: N/A Mpa

Anisotropy index, $I_a(50)$ = ____ = N/A

Remarks: 

COAL TESTED PERPENDICULAR TO BEDDING PLANE

Energy, Mines and Resources CANADA

POINT LOAD STRENGTH INDEX

Sample LINGAN - COAL

IRREGULAR LUMP

PERPENDICULAR TO BEDDING

Location MINE RUN AT 'SCALPER'

Borehole N/A Depth N/A

Sample No. N/A

Date 21-12-83

Tested by LSC

Pg. 283

Average water content: N/A %

Average degree of saturation: N/A %

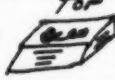
Test Type	Specimen No.	D (DIAM)	P (load)	D^2	Is	Is(50)	Median Value	Notes
POINT LOAD	21	50	2.050	0.0025	820			
	22	35	1.175	0.001225	959			
	23	50	2.525	0.0025	1010			
	24	35	1.850	0.001225	1510			
	25	40	2.275	0.0016	1422			
	26	25	2.025	0.000625	3240			
	27	50	2.525	0.0025	1010			
	28	40	2.850	0.0016	1781			
	29	20	3.150	0.0004	7875			
	30	55	1.775	0.003025	587			
	31	30	2.625	0.0009	2917			
	32	20	2.375	0.0004	5937			
	33	40	2.600	0.0016	1625			
	34	25	0.775	0.000625	1240			
	35	35	0.800	0.001225	653			
	36	25	1.175	0.000625	1880			
	37	40	2.775	0.0016	1734			
	38	35	2.050	0.001225	1673			
	39	25	2.750	0.000625	4400			
	40	35	1.150	0.001225	939			
CUM. TOTAL	710				43,212			

Median values of strength index, $I_s(50)$

Parellel to plane of weakness: N/A Mpa

Perpendicular to plane of weakness: N/A Mpa

Anisotropy index, $I_a(50)$ = ——— = N/A

Remarks: TOP  COAL TESTED PERPENDICULAR TO BEDDING PLANES

Energy, Mines and Resources CANADA

POINT LOAD STRENGTH INDEX

Sample LINGAN - COAL
IRREGULAR LUMP
PERPENDICULAR TO BEDDING
Location MINE RUN AT 'SCALPER'
Borehole N/A Depth N/A
Sample No. N/A

Date 21-12-83
Tested by [illegible]
Pg. 3 of 3
Average water content: N/A %
Average degree of saturation: N/A %

Test Type	Specimen No.	D (DIAM)	P (load)	D^2	Is	Is(50)	Median Value	Notes
POINT LOAD	41	40	4.350	0.0016	2719			
	42	30	0.850	0.0009	944			
	43	30	2.050	0.0009	2278			
	44	25	3.050	0.000625	4880			
	45	45	1.550	0.002025	765			
	46	35	1.850	0.001225	1510			
	47	55	1.850	0.003025	612			
	48	45	2.525	0.002025	1247			
	49	30	2.425	0.0009	2694			
	50	45	1.900	0.002025	938			
	51	35	1.975	0.001225	1612			
	52	30	1.925	0.0009	2139			
CUM.	TOTAL	445			23338			

TOTAL 1905 98924 MEAN I_S = $\frac{98924}{52}$ = 1902 KN/M² = 1.902 MPa

Median values of strength index, $I_s(50)$

Parellel to plane of weakness: N/A Mpa

Perpendicular to plane of weakness: N/A Mpa

Anisotropy index, $I_a(50)$ = ——— = N/A

AV. DIAM. = $\frac{1905}{52}$ = 36.63 mm = 0.03663 m

Remarks: TOP COAL TESTED PERPENDICULAR TO BEDDING PLANE

Energy, Mines and Resources CANADA

POINT LOAD STRENGTH INDEX

Sample LINGAN - COAL
IRREGULAR LUMP
PARALLEL TO BEDDING
Location MINE RUN AT 'SCALPER'
Borehole N/A Depth N/A
Sample No. N/A

Date JAN 3-/84
Tested by L. Stan O'Leary
pg. 18.3
Average water content: N/A %
Average degree of saturation: N/A %

Test Type	Specimen No.	D (DIAM)	P (load)	D^2	$I_s^{3/4}$ Is	Is(50)	Median Value	Notes
POINT LOAD	1	64	1.000	0.004	244			
	2	40	0.525	0.0016	328			
	3	49	0.525	0.002	219			
	4	47	1.625	0.002	736			
	5	24	1.050	0.0006	1823			
	6	19	0.800	0.0004	2216			
	7	51	2.625	0.0032	808			
	8	40	1.775	0.0016	1109			
	9	22	0.475	0.0005	361			
	10	51	1.900	0.0032	585			
	11	40	2.100	0.0016	1312			
	12	32	1.000	0.0010	977			
	13	27	0.700	0.0007	960			
	14	23	1.125	0.0005	2127			
	15	53	0.825	0.0028	293			
	16	50	1.875	0.0025	750			
	17	40	1.275	0.0016	797			
	18	29	0.650	0.0008	773			
	19	68	2.125	0.0046	460			
	20	58	1.325	0.0034	394			

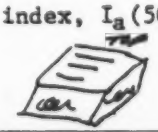
CUM. TOTAL 839 17892

Median values of strength index, $I_s(50)$

Parellel to plane of weakness: N/A Mpa

Perpendicular to plane of weakness: N/A Mpa

Anisotropy index, $I_a(50)$ = ____ = N/A

Remarks:  COAL TESTED PARALLEL TO PLANE.

Energy, Mines and Resources CANADA

POINT LOAD STRENGTH INDEX

Sample LINGAN COAL

IRREGULAR LUMP

PARALLEL TO BEDDING

Location MINE RUN AT 'SCALPER'

Borehole N/A Depth N/A

Sample No. N/A

Date JAN 5/84

Tested by PSoil

pg. 2 of 3

Average water content: N/A %

Average degree of saturation: N/A %

Test Type	Specimen No.	D (DIAM)	P (load)	D^2	Is	Is(50)	Median Value	Notes
POINT LOAD	21	41	1.825	0.0017	1086			
	22	30	1.025	0.0009	1139			
	23	66	1.500	0.0044	344			
	24	55	1.425	0.0030	471			
	25	44	1.275	0.0019	659			
	26	38	1.350	0.0014	935			
	27	28	1.175	0.0008	1499			
	28	69	1.125	0.0046	236			
	29	65	1.775	0.0042	420			
	30	47	0.600	0.0022	272			
	31	44	0.700	0.0019	362			
	32	54	2.025	0.0029	694			
	33	49	2.050	0.0024	854			
	34	38	1.825	0.0014	1264			
	35	29	0.400	0.0008	476			
	36	51	1.925	0.0026	740			
	37	35	0.375	0.00225	306			
	38	59	2.350	0.0035	675			
	39	46	1.525	0.0021	721			
	40	36	1.525	0.0013	1177			

CUM. TOTAL 924 14330

Median values of strength index, $I_s(50)$

Parellel to plane of weakness: N/A Mpa

Perpendicular to plane of weakness: N/A Mpa

Anisotropy index, $I_a(50)$ = ____ = N/A

Remarks: COAL TESTED PARALLEL TO PLANE

Energy, Mines and Resources CANADA

POINT LOAD STRENGTH INDEX

Sample LINGAN · COAL

IRREGULAR LUMP

PARALLEL TO BEDDING

Location MINE RUN AT 'SCRAPER'

Borehole N/A Depth N/A

Sample No. N/A

Date Jan. 5/84

Tested by ESOL

Pg. 393

Average water content: N/A %

Average degree of saturation: N/A %

Test Type	Specimen No.	D (DIAM)	P (load)	D^2	Is	Is(50)	Median Value	Notes
POINT LOAD	41	35	1.125	0.0012	918			
	42	74	1.500	0.0035	274			
	43	44	1.625	0.0019	839			
	44	38	0.550	0.0014	381			
	45	51	2.025	0.0026	779			
	46	34	1.675	0.0012	1449			
	47	46	1.075	0.0021	508			
	48	37	0.675	0.0014	493			
	49	35	1.150	0.001225	939			
	50	24	0.825	0.0006	1432			
	51	41	0.375	0.0017	223			
	52	38	0.400	0.0014	277			
	53	35	1.400	0.001225	1143			
	54	47	0.325	0.0022	147			
	55	45	1.000	0.002025	494			
CUM.	TOTAL	624			10296			
	TOTAL	2387			42518			

MEAN I_S = $\frac{42518}{55}$

= 773.05454 KN/m²

= 0.77305 MPa

AV. DIAM. = $\frac{2387}{55}$

= 43.4 mm

= 0.0434 m

Median values of strength index, $I_s(50)$

Parellel to plane of weakness: N/A Mpa

Perpendicular to plane of weakness: N/A Mpa

Anisotropy index, $I_a(50)$ = ——— = N/A

Remarks: TOP COAL TESTED PARALLEL TO BLANE

Energy, Mines and Resources CANADA

POINT LOAD STRENGTH INDEX

Sample LINGAN - COAL

IRREGULAR LUMP

PERPENDICULAR TO BEDDING

Location MINE RUN AT 'SCALPER'

Borehole N/A Depth N/A

Sample No. N/A

Date Jan. 5/84

Tested by LSOL

pg. 123.

Average water content: N/A %

Average degree of saturation: N/A %

Test Type	Specimen No.	D (DIAM)	P (load)	D^2	I_s 154	Is(50)	Median Value	Notes
POINT LOAD	1	12	0.200	0.00014	1389			
	2	33	3.200	0.0011	2939			
	3	28	2.675	0.000784	3413			
	4	16	0.600	0.000256	2344			
	5	36	2.850	0.001296	2199			
	6	26	1.375	0.000676	2034			
	7	41	2.325	0.001681	1383			
	8	14	0.250	0.000196	1275			
	9	30	1.435	0.0009	1595			
	10	23	0.525	0.000529	992			
	11	42	3.200	0.001764	1814			
	12	31	1.925	0.000961	2003			
	13	14	1.225	0.000196	6250	x		
	14	41	2.675	0.001681	1591			
	15	26	1.725	0.000676	2552			
	16	17	0.550	0.000289	1903			
	17	44	2.100	0.001936	1085			
	18	36	1.275	0.001296	984			
	19	22	2.050	0.000484	4237			
	20	23	1.175	0.000529	2221			
CUM. TOTAL		555			44203			

Median values of strength index, $I_s(50)$

Parellel to plane of weakness: N/A Mpa

Perpendicular to plane of weakness: N/A Mpa

Anisotropy index, $I_a(50)$ = ——— = N/A.

Remarks: SAMPLE TEST PERPENDICULAR TO BEDDING PLANE.

Energy, Mines and Resources CANADA

POINT LOAD STRENGTH INDEX

Sample LINGAN - COAL — Date JAN. 5/84

IRREGULAR LUMP — Tested by LAB'L

PERPENDICULAR TO BEDDING

pg. 293.

Location MINE RUN AT 'SCALPER'

Borehole N/A Depth N/A — Average water content: N/A %

Sample No. N/A — Average degree of saturation: N/A %

Test Type	Specimen No.	D (DIAM)	P (load)	D^2	Is	Is(50)	Median Value	Notes
POINT LOAD	21	20	2.700	0.0004	6752			
	22	37	0.625	0.001369	456			
	23	26	1.325	0.000676	1960			
	24	31	1.725	0.000961	1795			
	25	26	2.725	0.000676	4032			
	26	30	2.375	0.0009	2639			
	27	28	1.025	0.000784	1307			
	28	40	1.175	0.0016	734			
	29	25	1.875	0.000625	3000			
	30	31	2.000	0.000961	2081			
	31	24	1.550	0.000576	2691			
	32	36	1.325	0.001296	1022			
	33	24	1.475	0.000576	2561			
	34	29	3.125	0.000841	3716			
	35	37	1.025	0.001369	749			
	36	19	1.500	0.000361	4156			
	37	46	2.575	0.002116	1217			
	38	35	0.725	0.001225	592			
	39	25	1.075	0.000625	1720			
	40	40	2.100	0.0016	1312			

CUM. TOTAL 609 44492

Median values of strength index, $I_s(50)$

Parellel to plane of weakness: N/A Mpa

Perpendicular to plane of weakness: N/A Mpa

Anisotropy index, $I_a(50)$ = ——— = N/A

Remarks:

SAMPLE TESTED PERPENDICULAR TO BEDDING PLANE

Energy, Mines and Resources CANADA

POINT LOAD STRENGTH INDEX

Sample LINGAN - COAL

IRREGULAR LUMP

PERPENDICULAR TO BEDDING

Location MINE RUN AT 'SCALPER'

Borehole N/A Depth N/A

Sample No. N/A

Date JAN. 5/84

Tested by LSO'L

pg. 3 of 3.

Average water content: N/A %

Average degree of saturation: N/A %

Test Type	Specimen No.	D (DIAM)	P (load)	D^2	Is	Is(50)	Median Value	Notes
POINT LOAD	41	28	1.025	0.001681	610			
	42	20	1.200	0.0004	3000			
	43	40	1.100	0.0016	687			
	44	24	1.725	0.000576	2995			
	45	15	1.150	0.000225	5112			
	46	35	0.725	0.001225	592			
	47	28	0.775	0.000784	988			
	48	23	2.400	0.000529	4537			
	49	45	1.325	0.002025	654			
	50	32	1.775	0.001024	1733			
	51	25	1.025	0.000625	1640			
	52	29	1.675	0.000841	1992			
	53	19	2.525	0.000361	6995			
	54	45	1.125	0.002025	555			
	55	35	2.325	0.001225	1898			
CUM.	TOTAL	443			33991			
	TOTAL	1607			122,686			

MEAN I_S = $\frac{122,686}{55}$

= 2230.6545 KN/m²

= 2.231 MPa

AV. DIAM. = $\frac{1607}{55}$

= 29.218181 mm

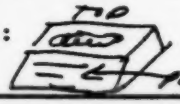
= 0.02922 m

Median values of strength index, $I_s(50)$

Parellel to plane of weakness: N/A Mpa

Perpendicular to plane of weakness: N/A Mpa

Anisotropy index, $I_a(50)$ = ——— = N/A

Remarks: TOP  PLANE SAMPLE TESTED PERPINDICULAR TO BEDDING PLANE

APPENDIX B

Energy, Mines and Resources CANADA

POINT LOAD STRENGTH INDEX

Sample NO. 26 COAL

IRREGULAR LUMP

PARALLEL TO BEDDING

Location MAIN COAL BELT

Borehole N/A Depth N/A

Sample No. N/A

Date 21-12-83

Tested by LSOL, WG + TA.

pg. 1 of 3

Average water content: N/A %

Average degree of saturation: N/A %

Test Type	Specimen No.	D (DIAM)	P (load)	D^2	Is	Is(50)	Median Value	Notes
POINT LOAD	1	40	0.450	0.0016	281			
	2	28	0.425	0.00078	545			
	3	42	0.475	0.00176	270			
	4	43	0.500	0.00185	270			
	5	46	0.600	0.00212	283			
	6	46	1.0000	0.00212	471			
	7	40	0.425	0.0016	265			
	8	36	1.0000	0.00130	769			
	9	48	0.525	0.00230	228			
	10	31	0.275	0.00096	286			
	11	31	0.450	0.00096	468			
	12	28	0.175	0.00078	224			
	13	24	0.325	0.00057	570			
	14	30	0.600	0.00090	666			
	15	27	0.800	0.00073	1096			
	16	55	N/R	—	—			NO READING
	17	18	N/R	—	-			NO READING
	18	19	0.550	0.00036	1528			
	19	19	0.600	0.00036	1666			
	20	33	0.775	0.00109	711			

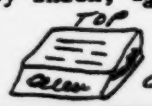
CUM. TOTAL. 684 10597

Median values of strength index, $I_s(50)$

Parellel to plane of weakness: N/A Mpa

Perpendicular to plane of weakness: N/A Mpa

Anisotropy index, $I_a(50)$ = ——— = N/A

Remarks: 

COAL TESTED PARALLEL TO BEDDING PLANE

Energy, Mines and Resources CANADA

POINT LOAD STRENGTH INDEX

Sample NO. 26 - COAL

IRREGULAR LUMP

PARALLEL TO BEDDING

Location MAIN COAL BELT

Borehole N/A Depth N/A

Sample No. N/A

Date 21-12-83

Tested by LSOL + WC + TA.

pg. 283

Average water content: N/A %

Average degree of saturation: N/A %

Test Type	Specimen No.	D (DIAM)	P (load)	D^2	Is	Is(50)	Median Value	Notes
POINT LOAD	21	41	0.670	0.00168	398			
	22	43	0.675	0.00185	364			
	23	40	0.800	0.0016	500			
	24	47	0.350	0.00221	158			
	25	48	0.475	0.00230	206			
	26	44	0.300	0.00194	154			
	27	53	1.450	0.00281	516			
	28	57	0.700	0.00325	215			
	29	50	1.300	0.0025	520			
	30	32	0.450	0.00102	441			
	31	26	0.250	0.00068	367			
	32	42	0.180	0.00176	102			
	33	50	0.625	0.0025	250			
	34	18	0.300	0.000324	937			
	35	37	1.200	0.00137	876			
	36	44	0.900	0.00194	464			
	37	20	N/R	—	—			NO READING
	38	37	0.800	0.00137	584			
	39	43	0.875	0.00185	473			
	40	42	0.350	0.00176	199			
CUM. TOTAL		814			7724			

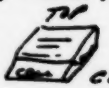
Median values of strength index, $I_s(50)$

Parellel to plane of weakness: N/A Mpa

Perpendicular to plane of weakness: N/A Mpa

Anisotropy index, $I_a(50)$ = ——— = N/A.

Remarks: TOP



COAL TESTED PARALLEL TO BEDDING PLANE

Energy, Mines and Resources CANADA

POINT LOAD STRENGTH INDEX

Sample NO. 26 - COAL

IRREGULAR LUMP

PARALLEL TO BEDDING

Location MAIN COAL BELT

Borehole N/A Depth N/A

Sample No. N/A

Date 21-12-83

Tested by LSH, WG + TH.

pg. 3 of 3

Average water content: N/A %

Average degree of saturation: N/A %

Test Type	Specimen No.	D (DIAM)	P (load)	D^2	Is	Is(50)	Median Value	Notes
POINT LOAD.	41	28	0.400	0.00078	513			
	42	27	0.300	0.00073	411			
	43	44	0.300	0.00194	154			
	44	35	0.550	0.00122	451			
	45	29	0.650	0.00084	773			
	46	33	0.750	0.00109	688			
	47	48	0.950	0.00230	413			
	48	36	0.800	0.00129	620			
	49	30	0.400	0.0009	444			
	50	38	0.700	0.00144	486			
	51	38	0.350	0.00144	243			
	52	50	0.050	0.0025	20			
	53	35	0.200	0.00122	164			
	54	50	0.400	0.0025	160			
	55	54	1.125	0.00292	385			
	56	50	1.100	0.0025	440			
CUM.	TOTAL	625			6365			
	TOTAL.	2123			24686			

Median values of strength index, $I_s(50)$

Parellel to plane of weakness: N/A Mpa

Perpendicular to plane of weakness: N/A Mpa

Anisotropy index, $I_a(50)$ = ——— = N/A

MEAN $I_S = \frac{24686}{53}$

$= 465.77358\ KN/M^2$

$= 0.46577\ MPa$

AV. DIAM. $= \frac{2123}{53}$

$= 40.056604\ mm$

$= 0.04006\ m$

Remarks: COAL TESTED PARALLEL TO BEDDING PLANE

Energy, Mines and Resources CANADA

POINT LOAD STRENGTH INDEX

Sample NO.26 - COAL

IRREGULAR LUMP

PERPENDICULAR TO BEDDING

Location MAIN COAL BELT

Borehole N/A Depth N/A

Sample No. N/A

Date 21-12-83

Tested by LSH + BG

pg. 183

Average water content: N/A %

Average degree of saturation: N/A %

Test Type	Specimen No.	D (DIAM)	P (load)	D^2	Is	Is(50)	Median Value	Notes
POINT LOAD	1	20	0.400	0.0004	1000			
	2	25	0.500	0.000625	800			
	3	—	N/R	—	—			
	4	35	0.275	0.001225	224			
	5	30	0.725	0.0009	805			
	6	45	1.800	0.002025	889			
	7	20	0.500	0.0004	1250			
	8	20	0.175	0.0004	437			
	9	60	0.975	0.0036	271			
	10	45	1.200	0.002025	592			
	11	30	0.950	0.0009	1055			
	12	20	0.250	0.0004	625			
	13	45	1.375	0.002025	679			
	14	35	0.175	0.001225	143			
	15	25	0.400	0.000625	640			
	16	20	1.175	0.0004	2937			
	17	—	N/R	—	—			
	18	45	0.725	0.002025	358			
	19	35	1.300	0.001225	1061			
	20	30	0.775	0.0009	861			
CUM. TOTAL		585			14627			

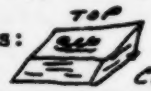
Median values of strength index, $I_s(50)$

Parellel to plane of weakness: N/A Mpa

Perpendicular to plane of weakness: N/A Mpa

Anisotropy index, $I_a(50)$ = — = N/A

Remarks: N/R - NO READING - SAMPLE FRACTURED



COAL TESTED PERPENDICULAR TO BEDDING PLANE

Energy, Mines and Resources CANADA

POINT LOAD STRENGTH INDEX

Sample NO. 26 - COAL

IRREGULAR LUMP

PERPENDICULAR TO BEDDING

Location MAIN COAL BELT

Borehole N/A Depth N/A

Sample No. N/A

Date 21-12-83

Tested by L80/+ B6

pg. 2 of 3.

Average water content: N/A %

Average degree of saturation: N/A %

Test Type	Specimen No.	D (DIAM)	P (load)	D^2	Is	Is(50)	Median Value	Notes
POINT LOAD	21	20	0.475	0.0004	1187			
	22	55	1.650	0.003025	545			
	23	45	2.225	0.002025	1099			
	24	25	0.500	0.000625	800			
	25	45	0.525	0.002025	259			
	26	30	0.700	0.0009	778			
	27	40	1.200	0.0016	750			
	28	25	0.700	0.000625	1120			
	29	35	1.000	0.001225	816			
	30	30	0.975	0.0009	1083			
	31	25	0.625	0.000625	1000			
	32	30	0.100	0.0009	111			
	33	25	0.475	0.000625	760			
	34	20	0.550	0.0004	1375			
	35	40	0.375	0.0016	234			
	36	30	0.200	0.0009	222			
	37	25	0.200	0.000625	320			
	38	40	0.700	0.0016	437			
	39	30	2.125	0.0009	2361			
	40	40	0.400	0.0016	250			
CUM. TOTAL		655			15507			

Median values of strength index, $I_s(50)$

Parellel to plane of weakness: N/A Mpa

Perpendicular to plane of weakness: N/A Mpa

Anisotropy index, $I_a(50)$ = ____ = N/A

Remarks: TOP

COAL TESTED PERPENDICULAR TO BEDDING PLANE

Energy, Mines and Resources CANADA

POINT LOAD STRENGTH INDEX

Sample NO. 26 - COAL

IRREGULAR LUMP

PERPENDICULAR TO BEDDING

Location MAIN COAL REZT

Borehole N/A Depth N/A

Sample No. N/A

Date 21-12-83

Tested by [illegible] + BG

Fig. 3 of 3.

Average water content: N/A %

Average degree of saturation: N/A %

Test Type	Specimen No.	D (DIAM)	P (load)	D^2	Is	Is(50)	Median Value	Notes
POINT LOAD	41	55	0.725	0.003025	240			
	42	35	0.900	0.001225	735			
	43	25	0.250	0.000625	400			
	44	55	1.400	0.003025	463			
	45	35	0.500	0.001225	408			
	46	35	1.175	0.001225	969			
	47	60	0.300	0.0036	83			
	48	50	1.475	0.0025	590			
	49	40	0.900	0.0016	562			
	50	55	1.425	0.003025	471			
	51	25	1.100	0.000625	1760			
	52	55	1.025	0.003025	339			
	53	40	0.825	0.0016	516			
	54	60	0.825	0.0036	229			
	55	45	0.975	0.002025	481			
	56	65	0.750	0.004225	177			
CUM.	TOTAL	735			8413			

TOTAL 1975 38547

MEAN I_s = 38547 / 54

= 713.83333 KN/m²

= 0.71383 MPa

Median values of strength index, $I_s(50)$

Parellel to plane of weakness: N/A Mpa

Perpendicular to plane of weakness: N/A Mpa

Anisotropy index, $I_a(50)$ = ——— = N/A

AV. DIAM. = 1975 / 54

= 36.574074 mm

= 0.03657 m

Remarks: COAL TESTED PERPENDICULAR TO BEDDING PLANE

APPENDIX C

Energy, Mines and Resources CANADA

POINT LOAD STRENGTH INDEX

Sample PRINCE MINE - COAL

IRREGULAR LUMP

PARALLEL TO BEDDING

Location MINE RUN AT 'SCALPER'

Borehole N/A Depth N/A

Sample No. N/A

Date Jan. 6/84

Tested by LSH

pg. 103

Average water content: N/A %

Average degree of saturation: N/A %

Test Type	Specimen No.	D (DIAM)	P (load)	D^2	Is	Is(50)	Median Value	Notes
POINT LOAD	1	42	1.125	0.0018	638			
	2	33	.525	0.0011	482			
	3	26	.325	0.0007	481			
	4	38	.475	0.0014	329			
	5	28	.200	0.0008	255			
	6	48	.875	0.0023	380			
	7	39	1.750	0.0015	1151			
	8	34	2.125	0.0012	1938			
	9	48	1.200	0.0023	521			
	10	19	1.925	0.0004	5333			
	11	51	2.275	0.0026	875			
	12	43	1.275	0.0018	690			
	13	31	.825	0.00096	858			
	14	28	2.125	0.00078	2711			
	15	51	2.000	0.0026	769			
	16	34	2.300	0.0012	1990			
	17	29	.675	0.0008	803			
	18	18	.525	0.0003	1620			
	19	15	.150	0.0002	667			
	20	51	2.850	0.0026	1096			
CUM. TOTAL		706			23487			

Median values of strength index, $I_s(50)$

Parellel to plane of weakness: N/A Mpa

Perpendicular to plane of weakness: N/A Mpa

Anisotropy index, $I_a(50)$ = ——— = N/A

Remarks: TOP TESTED PARALLEL TO BEDDING PLANE

Energy, Mines and Resources CANADA

POINT LOAD STRENGTH INDEX

Sample PRINCE MINE - COAL
IRREGULAR LUMP
PARALLEL TO BEDDING
Location MINE RUN AT 'SCALPER'
Borehole N/A Depth N/A
Sample No. N/A

Date Jan. 6/84.
Tested by ZSO'L

pg. 283

Average water content: N/A %
Average degree of saturation: N/A %

Test Type	Specimen No.	D (DIAM)	P (load)	D^2	Is	Is(50)	Median Value	Notes
POINT LOAD	21	42	.675	0.0019	383			
	22	34	.750	0.0012	649			
	23	29	1.225	0.0008	1457			
	24	25	.650	0.0006	1040			
	25	22	1.275	0.0005	2634			
	26	15	1.025	0.0002	4556			
	27	66	.500	0.0044	115			
	28	52	3.175	0.0027	1174			
	29	36	.900	0.0013	694			
	30	30	.775	0.0009	861			
	31	27	.875	0.0007	1200			
	32	11	.400	0.0001	3306			
	33	54	1.525	0.0029	523			
	34	42	.975	0.0018	553			
	35	33	.675	0.0011	620			
	36	28	.100	0.0008	127			
	37	24	1.350	0.0006	2344			
	38	20	.425	0.0004	1063			
	39	51	.925	0.0026	356			
	40	48	.675	0.0023	293			
		CUM. TOTAL 669			23948			

Median values of strength index, $I_s(50)$

Parellel to plane of weakness: N/A Mpa

Perpendicular to plane of weakness: N/A Mpa

Anisotropy index, $I_a(50)$ = ——— = N/A.

Remarks:

TESTED PARALLEL TO BEDDING PLANE

Energy, Mines and Resources CANADA

POINT LOAD STRENGTH INDEX

Sample PRINCE MINE - COAL
IRREGULAR LUMP
PARALLEL TO BEDDING
Location MINE RUN AT 'SCRAPER'
Borehole N/A Depth N/A
Sample No. N/A

Date Jan. 6/84.
Tested by ZSH

pg. 3 of 3.

Average water content: N/A %
Average degree of saturation: N/A %

Test Type	Specimen No.	D (DIAM)	P (load)	D^2	Is	Is(50)	Median Value	Notes
POINT LOAD	41	38	2.550	0.0014	1766			
	42	30	1.525	0.0009	1695			
	43	26	2.800	0.0007	4142			
	44	51	1.475	0.0026	567			
	45	34	.500	0.0012	432			
	46	29	1.375	0.0008	1635			
	47	25	.675	0.0006	1080			
	48	49	2.100	0.0024	875			
	49	34	1.125	0.0012	973			
	50	29	.700	0.0008	832			
	51	60	.625	0.0036	174			
	52	49	1.650	0.0024	687			
	53	39	3.025	0.0015	1989			
	54	24	2.075	0.0006	3604			
	55	64	1.025	0.0041	250			
	56	53	1.250	0.0028	445			
	57	41	1.775	0.0017	1056			
	58	30	1.325	0.0009	1472			
	59	31	1.725	0.00096	1795			
	60	28	1.000	0.0008	1275			

CUM. TOTAL 764 26744
TOTAL 2159 74179

Median values of strength index, $I_s(50)$

Parellel to plane of weakness: N/A Mpa

Perpendicular to plane of weakness: N/A Mpa

Anisotropy index, $I_a(50)$ = ——— = N/A

MEAN I_s = $\frac{74179}{60}$
= 1236.3166 KN/m²
= 1.2363 MPa

AV. DIAM. = $\frac{2159}{60}$
= 35.983333 mm
= 0.03598 m

Remarks: TOP

TESTED PARALLEL TO BEDDING PLANE

Energy, Mines and Resources CANADA

POINT LOAD STRENGTH INDEX

Sample PRINCE MINE - COAL
IRREGULAR LUMP
PERPENDICULAR TO BEDDING
Location MINE RUN AT 'SCALPER'
Borehole N/A Depth N/A
Sample No. N/A

Date Jan. 6/84
Tested by LSO'L
Pg. 183
Average water content: N/A %
Average degree of saturation: N/A %

Test Type	Specimen No.	D (DIAM)	P (load)	D^2	Is	Is(50)	Median Value	Notes
POINT LOAD	1	35	.875	0.001225	714			
	2	30	.500	0.0009	555			
	3	24	.200	0.0006	247			
	4	14	.125	0.0002	623			
	5	34	1.450	0.0012	1254			
	6	29	.825	0.0008	981			
	7	19	.225	0.0004	623			
	8	53	.800	0.0028	295			
	9	43	.775	0.0018	419			
	10	27	.925	0.0007	269			
	11	18	.200	0.0003	617			
	12	14	.050	0.0002	255			
	13	49	2.025	0.0024	843			
	14	31	.625	0.0014	456			
	15	34	.250	0.0012	216			
	16	53	1.000	0.0028	356			
	17	28	.975	0.0008	1244			
	18	19	.650	0.0004	1501			
	19	51	.900	0.0026	346			
	20	42	.400	0.0018	227			
CUM. TOTAL		653			13446			

Median values of strength index, $I_s(50)$

Parellel to plane of weakness: N/A Mpa

Perpendicular to plane of weakness: N/A Mpa

Anisotropy index, $I_a(50)$ = ____ = N/A

Remarks: TOP TESTED PERPENDICULAR TO BEDDING PLANE.

Energy, Mines and Resources CANADA

POINT LOAD STRENGTH INDEX

Sample PRINCE MINE - COAL
IRREGULAR LUMP
PERPENDICULAR TO BEDDING
Location MINE RUN AT 'SCRAPER'
Borehole N/A Depth N/A
Sample No. N/A

Date Jan. 6/84
Tested by [illegible]
pg. 293
Average water content: N/A %
Average degree of saturation: N/A %

Test Type	Specimen No.	D (DIAM)	P (load)	D^2	Is	Is(50)	Median Value	Notes
POINT LOAD	21	29	625	0.0009	743			
	22	15	.225	0.000225	1000			
	23	47	.875	0.0022	396			
	24	40	.675	0.0016	422			
	25	38	.425	0.0014	294			
	26	30	.500	0.0009	555			
	27	26	.175	0.0007	259			
	28	24	.475	0.0006	825			
	29	53	1.025	0.0028	365			
	30	38	2.175	0.0014	1506			
	31	31	.725	0.0008	754			
	32	23	.425	0.0005	803			
	33	40	.650	0.0016	406			
	34	37	.475	0.0014	347			
	35	30	.100	0.0009	111			
	36	28	1.175	0.0008	1499			
	37	43	1.450	0.0018	784			
	38	32	1.226	0.0010	1196			
	39	28	.225	0.0008	287			
	40	24	.725	0.0006	1259			
CUM. TOTAL		656			13811			

Median values of strength index, $I_s(50)$

Parellel to plane of weakness: N/A Mpa

Perpendicular to plane of weakness: N/A Mpa

Anisotropy index, $I_a(50)$ = ____ = N/A

Remarks: TOP TESTED PERPENDICULAR TO BEDDING PLANE

Energy, Mines and Resources CANADA

POINT LOAD STRENGTH INDEX

Sample PRINCE MINE - COAL
IRREGULAR LUMP
PERPENDICULAR TO BEDDING
Location MINE RUN AT 'SCALPER'
Borehole N/A Depth N/A
Sample No. N/A

Date Jan. 6/84
Tested by LSOL

pg. 3 of 3

Average water content: N/A %
Average degree of saturation: N/A %

Test Type	Specimen No.	D (DIAM)	P (load)	D^2	Is	Is(50)	Median Value	Notes
POINT LOAD	41	39	1.150	0.0015	756			
	42	32	.775	0.0010	757			
	43	27	1.000	0.0007	1372			
	44	38	.275	0.0014	190			
	45	30	.350	0.0009	389			
	46	24	.225	0.0006	391			
	47	21	.375	0.0004	850			
	48	45	.650	0.0020	321			
	49	40	.600	0.0016	375			
	50	36	.525	0.0013	405			
	51	32	.400	0.0010	391			
	52	29	.450	0.0008	535			
	53	54	.775	0.0029	266			
	54	38	.925	0.0014	641			
	55	33	1.175	0.0011	1079			
	56	22	.375	0.0005	775			
	57	60	1.450	0.0036	403			
	58	32	1.125	0.0010	1099			
	59	30	.100	0.0009	111			
	60	21	.225	0.0004	510			
CUM. TOTAL		683			11616			
TOTAL		1992			38873			

Median values of strength index, $I_s(50)$

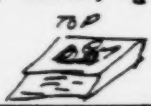
MEAN I_s = $\frac{38873}{60}$
= 647.88333 KN/m²
= 0.6479 MPa

Parellel to plane of weakness: N/A Mpa

Perpendicular to plane of weakness: N/A Mpa

Anisotropy index, $I_a(50)$ = ——— = N/A

AV. DIAM. = $\frac{1992}{60}$
= 33.2 mm
= 0.0332 m

Remarks: 

TESTED PERPINDICULAR TO BEDDING PLANE

APPENDIX D

Energy, Mines and Resources CANADA

POINT LOAD STRENGTH INDEX

Sample PT. ACONI. - NOVACO - COAL Date Jan. 6/84

IRREGULAR LUMP Tested by 280L

PARALLEL TO BEDDING

Location OPEN PIT 'CUT' pg. 103.

Borehole N/A Depth N/A Average water content: N/A %

Sample No. N/A Average degree of saturation: N/A %

Test Type	Specimen No.	D (DIAM)	P (load)	D^2	Is	Is(50)	Median Value	Notes
POINT LOAD	1	37	.725	0.0014	530			
	2	25	1.000	0.0006	1600			
	3	20	.100	0.0004	250			
	4	60	.675	0.0036	187			
	5	49	.125	0.0024	52			
	6	38	.500	0.0014	346			
	7	30	.700	0.0009	778			
	8	24	.125	0.0006	217			
	9	55	.425	0.0030	140			
	10	49	.100	0.0024	42			
	11	33	.375	0.0011	344			
	12	26	.025	0.0007	37			
	13	47	.600	0.0022	272			
	14	39	.875	0.0015	575			
	15	32	.400	0.0010	391			
	16	26	.250	0.0007	370			
	17	47	.200	0.0022	90			
	18	36	.375	0.0013	289			
	19	28	.700	0.0008	893			
	20	24	.375	0.000576	651			
CUM. TOTAL		725			8054			

Median values of strength index, $I_s(50)$

Parellel to plane of weakness: N/A Mpa

Perpendicular to plane of weakness: N/A Mpa

Anisotropy index, $I_a(50)$ = ——— = N/A.

Remarks:

TESTED PARALLEL TO BEDDING PLANE

Energy, Mines and Resources CANADA

POINT LOAD STRENGTH INDEX

Sample PT. ACONI - NOVACO - COAL

IRREGULAR LUMP

PARALLEL TO BEDDING

Location OPEN PIT 'CUT'

Borehole N/A Depth N/A

Sample No. N/A

Date Jan 6/84.

Tested by LSO

pg. 2 of 3

Average water content: N/A %

Average degree of saturation: N/A %

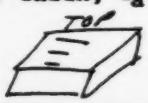
Test Type	Specimen No.	D (DIAM)	P (load)	D^2	Is	Is(50)	Median Value	Notes
POINT LOAD	21	58	.900	0.0034	238			
	22	51	.425	0.0026	163			
	23	34	.250	0.0012	216			
	24	25	.575	0.0006	920			
	25	20	.575	0.0004	1438			
	26	57	.525	0.0032	161			
	27	47	.975	0.0022	441			
	28	28	.100	0.0008	127			
	29	20	.475	0.0004	1187			
	30	43	.275	0.0018	149			
	31	35	.625	0.00125	510			
	32	26	.225	0.0006B	333			
	33	44	.775	0.0019	460			
	34	36	.025	0.0013	19			
	35	25	.425	0.0006	680			
	36	21	.700	0.0004	1587			
	37	71	.050	0.005	10			
	38	54	.275	0.0029	94			
	39	32	.700	0.0010	684			
	40	22	.350	0.0005	723			
CUM. TOTAL		749		10080				

Median values of strength index, $I_s(50)$

Parellel to plane of weakness: N/A Mpa

Perpendicular to plane of weakness: N/A Mpa

Anisotropy index, $I_a(50)$ = ____ = N/A

Remarks: 

TESTED PARALLEL TO BEDDING PLANE

Energy, Mines and Resources CANADA

POINT LOAD STRENGTH INDEX

Sample PR. ACONI – NOVACO – COAL

IRREGULAR LUMP

PARALLEL TO BEDDING

Location OPEN PIT ('CUT')

Borehole N/A Depth N/A

Sample No. N/A

Date Jan. 6/84

Tested by LSH

pg. 3 of 3

Average water content: N/A %

Average degree of saturation: N/A %

Test Type	Specimen No.	D (DIAM)	P (load)	D^2	Is	Is(50)	Median Value	Notes
POINT LOAD	41	31	.150	0.0006	156			
	42	22	.425	0.0005	876			
	43	18	.100	0.0003	309			
	44	43	.775	0.0018	419			
	45	32	.275	0.0010	269			
	46	19	.350	0.00036	970			
	47	45	.425	0.002025	210			
	48	41	.400	0.0017	238			
	49	25	.100	0.0006	160			
	50	20	.275	0.0004	687			
	51	42	.200	0.0018	113			
	52	39	.250	0.0015	164			
	53	29	.050	0.0008	59			
	54	20	.500	0.0004	1250			
	55	46	.225	0.0021	106			
CUM.	TOTAL	472			5988			
	TOTAL	1946			24122			

Median values of strength index, $I_s(50)$

Parellel to plane of weakness: N/A Mpa

Perpendicular to plane of weakness: N/A Mpa

Anisotropy index, $I_a(50)$ = ——— = N/A

MEAN I_S = $\frac{24122}{55}$

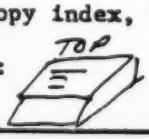
= 438.58181 KN/M²

= 0.43858 MR

AV. DIAM. = $\frac{1946}{55}$

= 35.381818 mm

= 0.03538 m

Remarks: 

TESTED PARALLEL TO BEDDING PLANE

Energy, Mines and Resources CANADA

POINT LOAD STRENGTH INDEX

Sample PR. ACONI - NOVACO - COAL

IRREGULAR LUMP

PERPENDICULAR TO BEDDING

Location OPEN PIT ('CUT')

Borehole N/A Depth N/A

Sample No. N/A

Date Jan. 6/84.

Tested by GSC

pg. 103.

Average water content: N/A %

Average degree of saturation: N/A %

Test Type	Specimen No.	D (DIAM)	P (load)	D^2	Is	Is(50)	Median Value	Notes
POINT LOAD	1	52	.300	0.0027	111			
	2	41	.150	0.0017	89			
	3	32	.175	0.0010	171			
	4	31	.200	0.000961	208			
	5	26	.050	0.0007	74			
	6	43	.225	0.0018	126			
	7	27	.025	0.0007	34			
	8	37	.800	0.0014	584			
	9	43	.475	0.0018	257			
	10	17	.200	0.0003	692			
	11	25	.025	0.000625	40			
	12	31	.200	0.000961	208			
	13	40	.275	0.0016	172			
	14	31	.275	0.000961	286			
	15	24	.200	0.00057	347			
	16	53	.375	0.0028	133			
	17	13	.050	0.00169	296			
	18	22	.025	0.00048	52			
	19	30	.050	0.0009	55			
	20	36	.450	0.00129	347			
CUM. TOTAL		654			4332			

Median values of strength index, $I_s(50)$

Parellel to plane of weakness: N/A Mpa

Perpendicular to plane of weakness: N/A Mpa

Anisotropy index, $I_a(50)$ = ——— = N/A

Remarks:

TESTED PERPENDICULAR TO BEDDING PLANE.

Energy, Mines and Resources CANADA

POINT LOAD STRENGTH INDEX

Sample PT. ACONI - NOVACO - COAL

IRREGULAR LUMP

PERPENDICULAR TO BEDDING

Location OPEN PIT 'CUT'

Borehole N/A Depth N/A

Sample No. N/A

Date Jan. 6/84.

Tested by L Sol

pg. 283

Average water content: N/A %

Average degree of saturation: N/A %

Test Type	Specimen No.	D (DIAM)	P (load)	D^2	Is	Is(50)	Median Value	Notes
POINT LOAD	21	18	.025	0.0003	77			
	22	21	.450	0.0004	1020			
	23	30	.050	0.0009	55			
	24	37	.100	0.001369	73			
	25	26	.125	0.00067	185			
	26	22	.025	0.00048	52			
	27	33	.375	0.001089	344			
	28	24	.200	0.00057	347			
	29	47	.275	0.002209	124			
	30	21	.400	0.00044	907			
	31	17	.050	0.00028	173			
	32	34	.050	0.00115	43			
	33	26	.375	0.00067	555			
	34	18	.300	0.00032	926			
	35	16	.200	0.00025	781			
	36	37	.200	0.001369	146			
	37	36	.200	0.001296	154			
	38	22	.100	0.00048	207			
	39	37	.275	0.001369	201			
	40	32	.275	0.0010	269			

CUM TOTAL 554 6039

Median values of strength index, $I_s(50)$

Parellel to plane of weakness: N/A Mpa

Perpendicular to plane of weakness: N/A Mpa

Anisotropy index, $I_a(50)$ = ____ = N/A

Remarks:

TESTED PERPENDICULAR TO BEDDING PLANE

Energy, Mines and Resources CANADA

POINT LOAD STRENGTH INDEX

Sample PT. ACONI - NOVACO - COAL
IRREGULAR LUMP
PERPENDICULAR TO BEDDING

Location OPEN PIT 'CUT'

Borehole N/A Depth N/A

Sample No. N/A

Date Jan. 6/84

Tested by LSOR

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Average water content: N/A %

Average degree of saturation: N/A %

Test Type	Specimen No.	D (DIAM)	P (load)	D^2	Is	Is(50)	Median Value	Notes
POINT LOAD	41	20	.300	0.0004	750			
	42	26	.400	0.000676	592			
	43	26	.275	0.000676	407			
	44	30	.125	0.0009	139			
	45	44	.175	0.001936	90			
	46	40	.375	0.0016	234			
	47	36	.400	0.001296	309			
	48	25	.875	0.000625	1400			
	49	20	.325	0.0004	812			
	50	36	.050	0.001296	39			
	51	26	.050	0.000676	74			
	52	34	.725	0.001156	627			
	53	36	.400	0.001296	309			
	54	30	.450	0.0009	500			
	55	26	.175	0.000676	259			
CUM.	TOTAL	455			6541			
TOTAL		1663			17512			

MEAN I_S = $\frac{17512}{55}$ = 318.4 KN/m² = 0.3184 MR

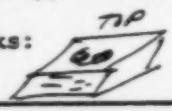
Median values of strength index, $I_S(50)$

Parellel to plane of weakness: N/A Mpa

Perpendicular to plane of weakness: N/A Mpa

Anisotropy index, $I_a(50)$ = ____ = N/A

AV. DIAM. = $\frac{1663}{55}$ = 30.236363 mm = 0.030236 m

Remarks: 

TESTED PERPENDICULAR TO BEDDING PLANE.